Department of Energy
Office of Legacy Management

June 8, 2006

Ms. Carol Rushin
Office of Enforcement, Compliance and Environmental Justice
U.S. Environmental Protection Agency, Region VIII
999 18th Street, Suite 300
Denver, CO 80202

Mr. Arch Crouse
Colorado Department of Public Health and Environment
Air Pollution Control Division, SSP-B1
430 Cherry Creek Drive South
Denver, CO 80246-1530

Subject: Rocky Flats Environmental Technology Site Calendar Year 2005 Radionuclide Air Emissions Annual Report

Dear Ms. Rushin and Mr. Crouse

Enclosed is the Rocky Flats Environmental Technology Site Calendar Year 2005 Radionuclide Air Emissions Annual Report, as required by Title 40, Code of Federal Regulations, Part 61, Subpart H (Subpart H). The Site was in compliance with the Subpart H standard as implemented through the Permit requirements for 2005.

If you require additional information or have any questions, please call me. I may be reached at (303) 966-3551.

Sincerely,

Scott Surovchak
Site Manager

cc w/enclosure:
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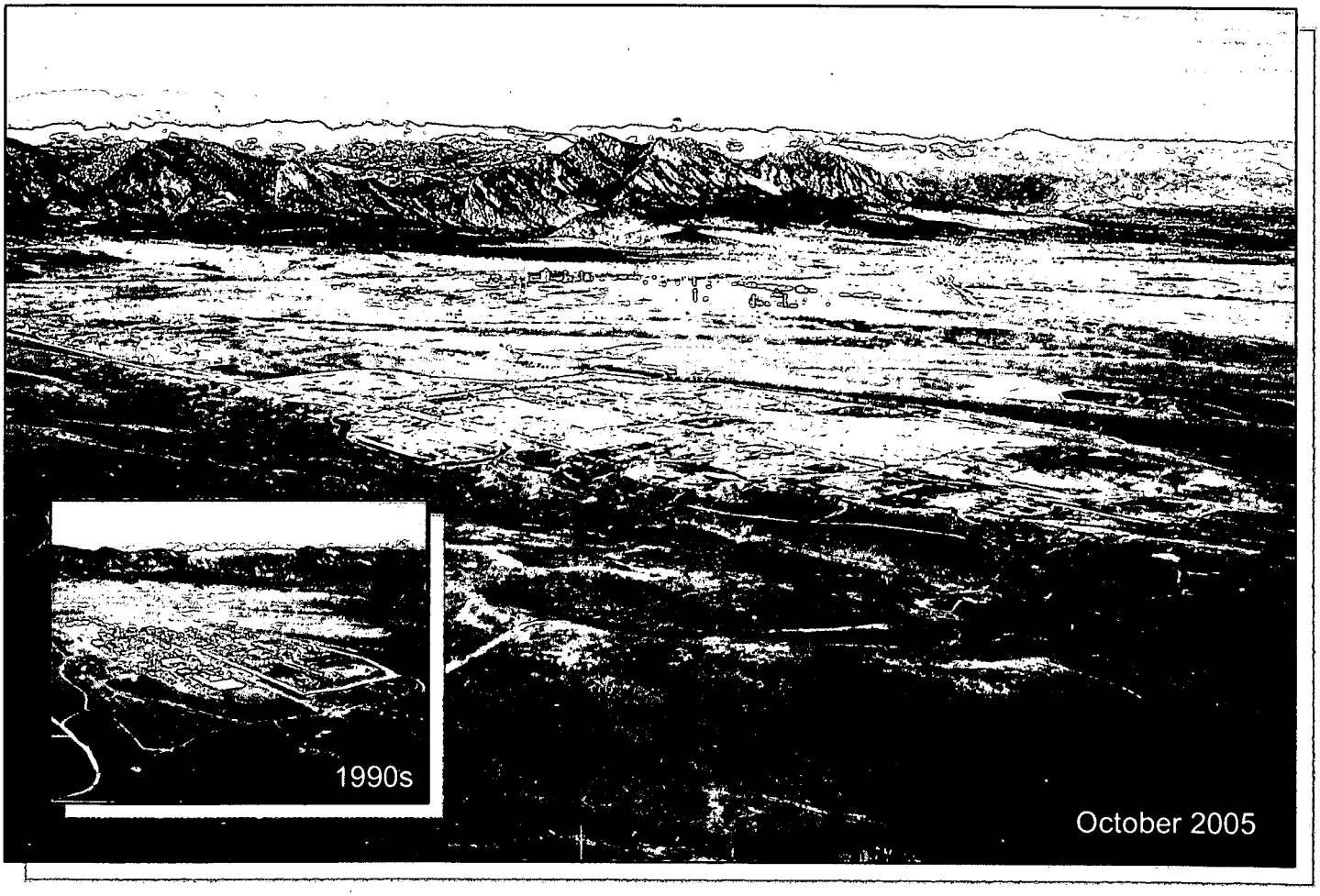
US Department of Energy

Radionuclide Air Emissions Annual Report Calendar Year 2005

Rocky Flats Environmental Technology Site



Radionuclide Air Emissions Annual Report for Calendar Year 2005

Prepared in accordance with
40 CFR 61, Subpart H
and
CAQCC Regulation No. 8, Part A, Subpart H

Site Name: Rocky Flats Environmental Technology Site

Office: Office of Legacy Management

Address: US Department of Energy
Legacy Management
12101 Airport Way, Unit C
Broomfield, Colorado 80021-2583

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Exempt from classification per CEX-105-01

EXECUTIVE SUMMARY

As required by Title 40 of the Code of Federal Regulations (CFR), Part 61, Subpart H, and Colorado Air Quality Control Commission Regulation No. 8, Part A, Subpart H, the airborne radiation dose to the public from the Rocky Flats Environmental Technology Site (Site) has been determined and annually reported to the US Environmental Protection Agency and the Colorado Department of Public Health and Environment. These regulations limit the air pathway dose from Site activities to any member of the public to an effective dose equivalent (EDE) of 10 millirem (mrem) in any year. The Site was in compliance with the 10-mrem standard during 2005.

Over the past several years, the Site has undergone decommissioning and environmental restoration activities pursuant to the *Rocky Flats Cleanup Agreement* (DOE, et al., 1996). As of September 28, 2005, all accelerated actions were complete and no buildings, structures, or operations remained that had the potential to emit radionuclides. As a result, the remaining US Department of Energy-retained lands are no longer a "facility" as defined in 40 CFR 61.91(b) and 40 CFR 61, Subpart H, no longer applies. This report fulfills the reporting requirement of the regulation for the 2005 calendar year and will be the final annual report submitted under this requirement.

Compliance with the 10-mrem standard was determined for 2005 by comparing environmental radionuclide air concentration measurements at the critical receptor location with the "Concentration Levels for Environmental Compliance" listed in Table 2 of Appendix E to 40 CFR 61. Compliance is demonstrated when each measured radionuclide air concentration is less than its corresponding compliance level in Table 2 and when the fractional sum of all radionuclides is less than 1. For 2005, each measured radionuclide air concentration was less than 3% of the corresponding concentration level for environmental compliance and the fractional sum of all radionuclides was less than 3% of the allowable level at the sampler with the highest fractional sum (the critical receptor). The highest fractional sum measured in 2005 corresponds to a 9-month calendar year dose of 0.275 mrem (2.75% of the 10-mrem standard) and a rolling 12-month dose of 0.227 mrem (2.27% of the 10-mrem standard).

Airborne radionuclides appear to have been dominated by naturally occurring uranium isotopes at most sampling locations in 2005, as has been the case in previous years. Across all compliance samplers, uranium isotopes characteristic of naturally occurring uranium contributed an average of 67% of the fractional sum.

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ABBREVIATIONS AND ACRONYMS

Am	Americium
Bq	Becquerel(s)
CAP88-PC	Clean Air Act Assessment Package-1988
CAQCC	Colorado Air Quality Control Commission
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	Curie(s)
Ci/m^3	Curies per cubic meter
Ci/yr	Curies per year
cm	Centimeter(s)
cm^2	Square centimeter(s)
DOE	US Department Of Energy
dpm	Disintegrations per minute
DRCOG	Denver Regional Council of Governments
EDE	Effective dose equivalent
EIS	Effluent Information System
EPA	US Environmental Protection Agency
HEPA	High efficiency particulate air (filter)
Kaiser-Hill	Kaiser-Hill Company, LLC
km	Kilometer(s)
km^2	Square kilometer(s)
LM	[DOE] Office of Legacy Management
m	Meter(s)
m^2	Square meter(s)
m^3	Cubic meters(s)
mrem	Millirem(s)
m/s	Meters per second
mSv	MilliSievert(s)
N	Number of samples analyzed
ODIS	On-Site Discharge Information System
Pu	Plutonium
pCi/g	Picocuries per gram
RAAMP	Radioactive Ambient Air Monitoring Program
RCRA	Resource Conservation and Recovery Act
rem	Reference man
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFPO	Rocky Flats Project Office
Site	Rocky Flats Environmental Technology Site
Sv	Sievert(s)
TRU	Transuranic
U	Uranium

USC	United States Code
USFWS	US Fish and Wildlife Service
°C	Degrees Celsius
µCi	Microcurie(s)

1.0 INTRODUCTION

Title 40 of the Code of Federal Regulations (CFR), Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities," applies to operations at any facility owned or operated by the US Department of Energy (DOE) that emits radionuclides (other than radon-222 and radon-220) into the air. The standard requires that emissions of radionuclides to the ambient air not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent (EDE) of 10 millirem (mrem) (0.1 milliSieverts [mSv]). Colorado has incorporated 40 CFR 61, Subpart H, by reference as Colorado Air Quality Control Commission (CAQCC) Regulation No. 8, Part A, Subpart H.

The Rocky Flats Environmental Technology Site (RFETS or Site) has historically been subject to 40 CFR 61, Subpart H. However, the Site has undergone decommissioning and environmental restoration activities pursuant to the *Rocky Flats Cleanup Agreement* (RFCA; DOE, et al., 1996), with physical completion (including building demolition, waste shipment, soil remediation, and surface water protection) accomplished in Fall 2005. As of September 28, 2005, all accelerated actions were complete and no buildings, structures, or operations remained that had the potential to emit radionuclides. As a result, the remaining DOE-retained lands are no longer a "facility" as defined in 40 CFR 61.91(b) and 40 CFR 61, Subpart H, no longer applies.

Following regulatory completion (including completion of all obligations under RFCA and delisting from the National Priorities List), administrative jurisdiction of most of the Site will be turned over to the US Department of the Interior, to be managed by the US Fish and Wildlife Service (USFWS) as a National Wildlife Refuge. The USFWS-managed portion of the former RFETS will not be subject to the requirements of 40 CFR 61, Subpart H.

1.1 Calendar Year 2005 Compliance Demonstration and Annual Report

Regulation 40 CFR 61, Subpart H, Section 61.94, requires the Site to demonstrate compliance with the standard for the previous calendar year and to submit this information, along with other data, to the US Environmental Protection Agency (EPA) in an annual report (CAQCC Regulation No. 8, Part A, Subpart H, requires submittal to the Colorado Department of Public Health and Environment [CDPHE]). This report fulfills the reporting requirements of 40 CFR 61.94 and CAQCC Regulation No. 8, Part A, Section 61.94, for the 2005 calendar year.

In 1997, DOE filed an application with EPA and CDPHE requesting approval of an alternative compliance demonstration method for 40 CFR 61, Subpart H (DOE, 1997). The alternative method is based on environmental measurements of radionuclide air concentrations at critical receptor locations, rather than the dispersion modeling approach outlined in the regulation itself. In cases where nonpoint sources of emissions are the primary contributors to dose, as has been the case at the Site since before 1995, such an alternative method based on environmental measurements is recommended by EPA (EPA, 1991).

The alternative compliance demonstration method was approved by CDPHE and EPA. The compliance sampling network, which consisted of 14 samplers located around the perimeter of the Site, became fully operational in 1999. These samplers were part of the Site's Radioactive Ambient Air Monitoring Program (RAAMP) network. Compliance has been determined using the alternative method for this annual report.

1.2 Transition Activities

Following completion of accelerated actions under RFCA and removal of all buildings, structures, and operations emitting airborne radionuclides, sampling at 11 of the 14 compliance sampling locations was discontinued. Ambient air monitoring will be continued by DOE voluntarily at the remaining three locations to confirm low emissions from the limited surface soil radionuclide contamination that remains following physical completion. Wind erosion will result in ongoing emissions of small amounts of particle-bound radionuclides from these areas.

Two of the remaining sampling locations are situated in a downwind direction under prevailing higher speed winds and in locations where typically the highest potential dose has been estimated through modeling using representative meteorological conditions at the Site. The third location is situated west of the Site, and will be used to compare predominantly upwind radionuclide air concentrations to concentrations at downwind locations. The upwind location is known to not be representative of Site emissions, due to a significant contribution of natural uranium and its progeny from wide-spread sand and gravel mining operations immediately east and southeast of the sampling location. The two downwind locations are those that would be appropriate to measure Site emissions based on the alternative compliance demonstration guidance given in EPA's *Guidance on Implementing the Radionuclide NESHAPs* (EPA, 1991).

It is expected that sampling will continue for approximately three years. This time frame was selected since continued recovery of vegetation on Site will further reduce dust emissions over time. Consequently, absent additional disturbances, highest emissions should occur immediately following completion of accelerated actions and before full vegetative recovery.

The results of the ambient radionuclide air monitoring will be reported annually to CDPHE and EPA in a manner consistent with other data reporting performed under RFCA, subject to the ambient air monitoring schedule.

2.0 FACILITY INFORMATION

This section describes the Rocky Flats Environmental Technology Site, lists the radioactive materials that were present at the Site in 2005, and describes the handling and processing that the radioactive materials underwent. New construction or modifications in calendar year 2005 for which construction approval and startup notification were waived per 40 CFR 61.96 are also identified in this section. Construction approval and startup notification were not required for any new construction or modification in 2005.

2.1 Site Description

Cleanup and closure activities during 2005 were accomplished by Kaiser-Hill Company, LLC (Kaiser-Hill), with oversight by DOE's Rocky Flats Project Office (RFPO). Prior to 1989, the Site fabricated nuclear weapons components from plutonium, uranium, beryllium, and stainless steel. Production activities included metal fabrication and assembly, chemical recovery and purification of process-produced transuranic (TRU) radionuclides, and related quality control functions. Plutonium weapons operations were curtailed at the Site in 1989 due to safety concerns, and in February 1992, the Site's weapons production mission was discontinued.

In 2005, activities at the Site included building demolition, waste management and shipment, and environmental cleanup. Accelerated actions were completed in Fall 2005. DOE's Office of Environmental Management, which was responsible for the cleanup, is transitioning the lands that DOE retains to DOE's Office of Legacy Management (LM). LM was established in December 2003 to conduct long-term management activities for DOE sites that no longer support DOE's ongoing missions, including disposal sites and remediated sites such as RFETS.

The Site occupies an area of 26.5 square kilometers (km^2) in northern Jefferson County, Colorado, about 25.7 kilometers (km) northwest of Denver. The Site is located at approximately 1,829 meters (m) above mean sea level on the eastern edge of a geological bench known locally as Rocky Flats. This bench, about 8.1 km wide in an east-west direction, flanks the eastern edge of the Rocky Mountains.

Over 3 million people live within 80 km of the Site. Adjacent land use is a mixture of agriculture, open space, industry, and residential housing. Surrounding communities include the city of Golden to the south of the Site; the cities of Arvada, Broomfield, and Westminster to the east; and the cities of Boulder and Superior to the north. An area map is shown in Figure 2-1.

The former production facilities were located near the center of the Site in the Industrial Area. The remaining Site area historically contained support facilities and served as a buffer zone surrounding the former production facilities. During 2005, the last Site structures were demolished, waste and debris were dispositioned, environmental restoration required by RFCA was completed, and the remediated land configuration was accomplished. A simplified map of the Site is shown in Figure 2-2.

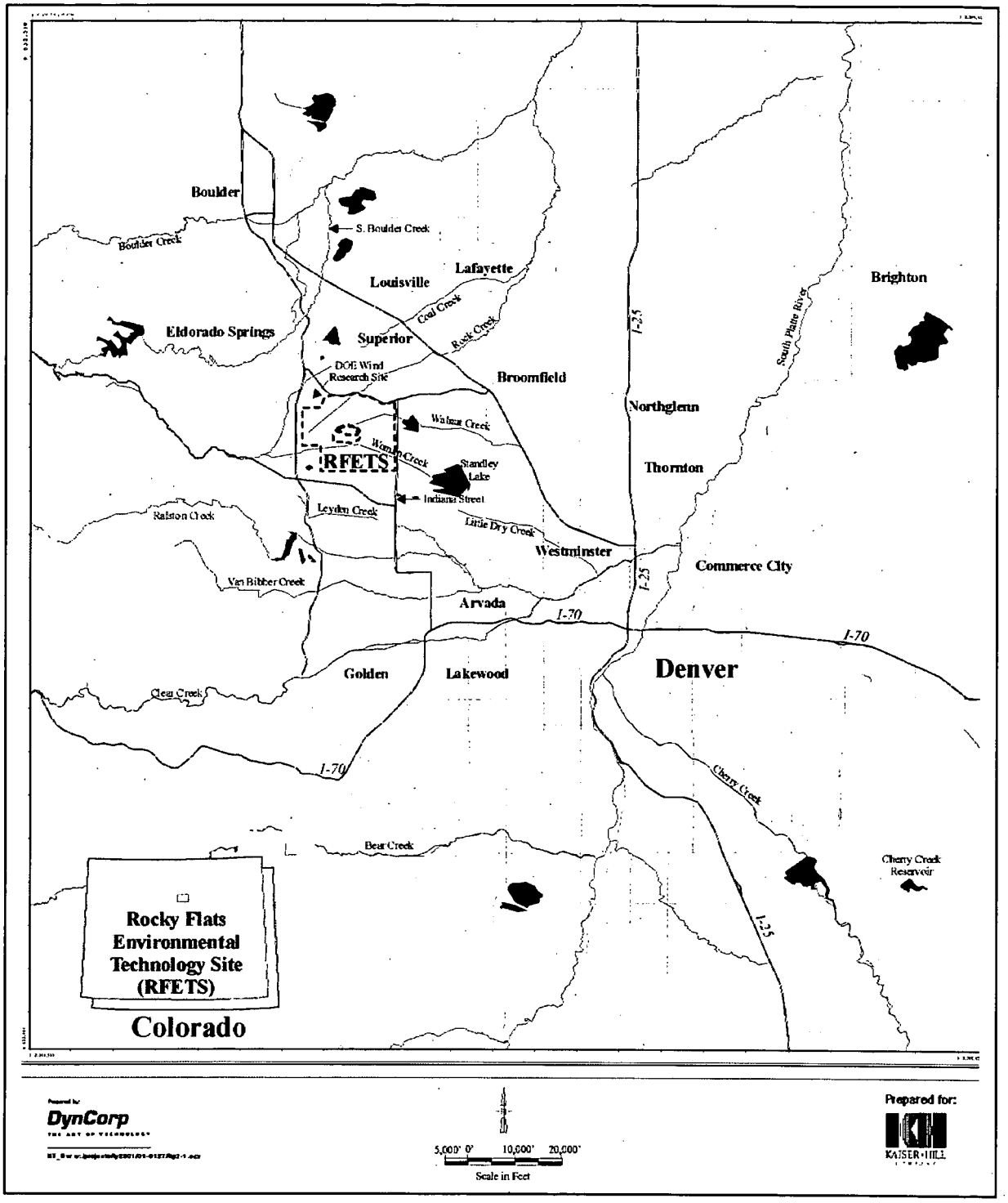


Figure 2-1. Area Map of the Rocky Flats Environmental Technology Site and Surrounding Communities

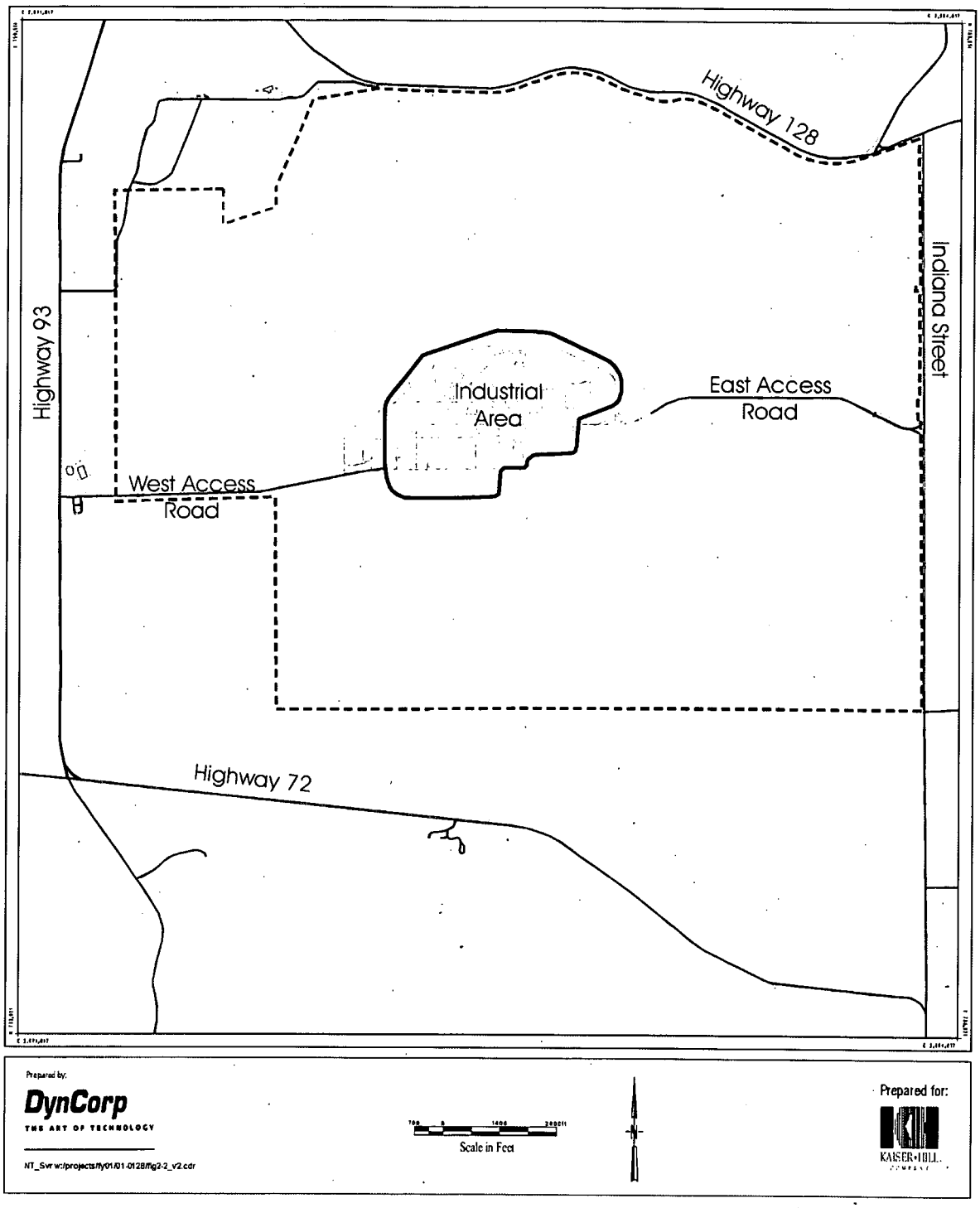


Figure 2-2. Rocky Flats Environmental Technology Site Location Map

2.2 Radionuclide Air Emissions Source Description

Activities involving radioactive material handling at the Site during 2005 focused on environmental restoration, building decommissioning and demolition, waste processing, and shipping support. Most of the radionuclide air emissions from the Site resulted from nonpoint (diffuse) sources, including mechanical and natural disturbances of contaminated soil and debris. Soil contamination was caused by past radioactive material spills and other releases. In addition, the soils on and around the Site contain naturally occurring radionuclides. Decommissioning and demolition of former processing buildings also contributed to diffuse radionuclide emissions.

Past weapons-related activities in Site buildings resulted in residual radioactive material being deposited in Site ventilation systems and associated equipment such as gloveboxes. Some residual material may have been resuspended and released through the single significant point source that remained in 2005 (Building 440), as well as several insignificant sources that operated early in 2005. The effluent from Building 440 was cleaned prior to release by passing it through multiple stages of high efficiency particulate air (HEPA) filters; resulting in very low point source emissions in 2005.

2.2.1 Radioactive Materials Handling During Calendar Year 2005

In 2005, radionuclide emissions from the Site occurred from several activities that either disturbed contamination in buildings, soil, or debris, or that used radionuclide-containing substances such that emissions to the atmosphere resulted. Appendix A lists radioactive materials associated with the Site during 2004, including plutonium (Pu)-239/240, americium (Am)-241, uranium (U)-233/234, U-235, and U-238; lesser quantities would have been on-Site during 2005.

Sources of Site radionuclide emissions in calendar year 2005 included:

- **Disturbance of hold–up in ducts.** Radionuclide emissions were generated through disturbance of radionuclide-contaminated dust and other deposits on the surfaces of ventilation ducts exiting former process areas. Routine air movement, as well as decontamination and equipment removal or reconfiguration activities, disturbed hold-up in certain ducts in 2005. As long as building ventilation systems remained operational, ducts containing hold-up were vented through multiple stages of HEPA filters.
- **Disturbance of resident contamination on equipment or room surfaces.** As with hold-up, resident contamination was emitted in 2005 due to routine exposure to ventilation air and due to active disturbance by project activities, particularly decontamination and equipment movement. To the extent practicable, ducts venting areas with contamination were exhausted through multiple stages of HEPA filters.
- **Waste handling.** In 2005, solid waste was segregated and size-reduced prior to packaging for storage and disposal. Such activities disturbed the radioactive contamination in the waste, resulting in radioactive particles in the room air. In addition, routine emissions from tank vents and liquid radioactive waste movement projects contributed to emissions during 2005. These activities took

place inside buildings or other structures, and, where feasible, venting the air through HEPA filters controlled emissions from these operations.

- **Waste storage.** Packaged radioactive wastes were stored in drums prior to shipping. Drums were vented to prevent pressure buildup from hydrogen gas, which is generated by radiolytic activity affecting packaged materials (these are considered sealed sources). Radionuclide emissions would only occur during venting if the inner packaging failed. To minimize emissions should the inner packaging fail, the drums were equipped with small filter cartridges that functioned like HEPA filters.
- **Waste repackaging.** Radionuclide emissions were generated in 2005 from waste characterization and repackaging activities to support waste shipment activities. Most of the waste repackaging activities that occurred in 2005 took place in areas that were vented through HEPA filters.
- **Building/structure demolition projects.** Demolition projects at the Site were performed in accordance with RFCA. RFCA is a negotiated, interagency agreement governing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) cleanup activities at the Site. In most cases, contaminated systems were decontaminated and removed prior to demolition.

  Structures that were demolished in 2005 that may have resulted in radionuclide emissions included Buildings 707, 776, 444, 883, 528, 559, 371, and 374.
- **Miscellaneous point sources.** Miscellaneous point source operations that continued to operate during part of 2005 included an intermittent drum crushing activity at the 750 Pad, Tent 5; the Trailer 130A laboratory; 750 Pad, Tent 5 TRU-mixed waste sludge, low level waste, and low level mixed waste repackaging, and waste chemical repackaging at the 750 Pad, Tent 5.
- **Miscellaneous nonpoint sources.** Another contributor to Site radionuclide emissions in 2005 was the resuspension of contaminated soil particles by wind erosion, vehicle traffic, and other mechanical soil disturbances. Miscellaneous nonpoint sources that emitted radionuclides in 2005 included the B-series ponds remediation (continued from 2004) and Building 776 soil remediation.

2.2.2 New Construction and Modifications in Calendar Year 2005

Ten new or modified activities that contributed to the Site air pathway dose in calendar year 2005 are described below. As part of the project evaluation process (prior to the startup of each project), the maximum annual (controlled) off-Site EDE that could result from each new or modified activity was calculated to determine approval and notification requirements. Maximum potential radionuclide emissions were estimated using emission and control factors from Appendix D to 40 CFR 61, combined with information regarding radionuclide contaminant levels and material forms, radionuclide release mechanisms, and the radionuclide emission controls employed. In cases where HEPA filters were employed, credit was taken for a maximum of two stages, although up to four stages may actually have been employed. Emissions were modeled using the Clean Air

Act Assessment Package-1988 (CAP88-PC), and recent Site meteorological data to estimate annual EDEs at the most impacted off-Site residence and business locations.

Detailed data and calculations used to develop emission estimates and resulting dose projections are maintained in archived Site files. The estimated EDE (shown below) for each new construction or modification was less than 1% of the 10-mrem (0.1-mSv) standard, and construction approval and startup notification were unnecessary under 40 CFR 61.96.

The project- or process-specific EDEs used in making regulatory applicability decisions regarding approval requirements are discussed below.

Building 707 Demolition: Building 707 was demolished in 2005. The building did not meet free release criteria for radionuclide contamination. Total weapons grade plutonium activity present when the building was demolished was estimated to be 147.257 microcuries (μCi).

The EDE estimation used the total estimated plutonium activity, and the demolition release rate approved in the peer reviewed *Building 776/777 Air Modeling Technical Document* (Kaiser-Hill, 2002). The maximum annual off-Site EDE from the project was estimated to be 3.6×10^{-7} mrem (3.6×10^{-9} mSv).

Building 444 Cluster Demolition: The Building 444 Cluster (Buildings 444, 445, and 450) was demolished in 2005. The building cluster did not meet free release criteria for radionuclide contamination and was designated as a Type II facility. Total fixed depleted uranium mass present when the cluster was demolished was estimated to be 7.15×10^{3} grams.

The EDE estimation used the total estimated depleted uranium activity, and the demolition release rate approved in the peer reviewed *Building 776/777 Air Modeling Technical Document* (Kaiser-Hill, 2002). The maximum annual off-Site EDE from the project was estimated to be 2.2×10^{-6} mrem (2.2×10^{-8} mSv).

Building 883 Demolition: Building 883 was demolished in 2005. The building did not meet free release criteria for radionuclide contamination. Total depleted uranium mass present when the building was demolished was estimated to be 1.36×10^{5} grams.

The EDE estimation used the total estimated depleted uranium activity, and the demolition release rate approved in the peer reviewed *Building 776/777 Air Modeling Technical Document* (Kaiser-Hill, 2002). The maximum annual off-Site EDE from the project was estimated to be 4.9×10^{-5} mrem (4.9×10^{-7} mSv).

Building 528 Demolition: Building 528 was demolished in 2005. The building did not meet free release criteria for radionuclide contamination. Total weapons grade plutonium mass present when the building was demolished was estimated to be 0.1 grams.

The EDE estimation used the total estimated weapons grade plutonium activity, and the demolition release rate approved in the peer reviewed *Building 776/777 Air Modeling Technical Document* (Kaiser-Hill, 2002). The maximum annual off-Site EDE from the project was estimated to be 2.0×10^{-5} mrem (2.0×10^{-7} mSv).

Building 559 Demolition: Building 559 was demolished in 2005. The building did not meet free release criteria for radionuclide contamination. Total weapons grade plutonium mass present when the building was demolished was estimated to be 0.243 grams.

The EDE estimation used the total estimated weapons grade plutonium activity, and the demolition release rate approved in the peer reviewed *Building 776/777 Air Modeling Technical Document* (Kaiser-Hill, 2002). The maximum annual off-Site EDE from the project was estimated to be 4.8×10^{-5} mrem (4.8×10^{-7} mSv).

Building 374 Demolition: Building 374 was demolished in 2005. The building did not meet free release criteria for radionuclide contamination. Total weapons grade plutonium activity present when the building was demolished was estimated to be 7.2×10^{-8} curies.

The EDE estimation used the total estimated weapons grade plutonium activity, and the demolition release rate approved in the peer reviewed *Building 776/777 Air Modeling Technical Document* (Kaiser-Hill, 2002). The maximum annual off-Site EDE from the project was estimated to be 1.5×10^{-6} mrem (1.5×10^{-8} mSv).

Building 371 Demolition: Building 371 was demolished in 2005. The building did not meet free release criteria for radionuclide contamination. Total weapons grade plutonium activity present when the building was demolished was estimated to be less than 1 gram.

The EDE estimation used the total estimated weapons grade plutonium activity, and the demolition release rate approved in the peer reviewed *Building 776/777 Air Modeling Technical Document* (Kaiser-Hill, 2002). The maximum annual off-Site EDE from the project was estimated to be 1.8×10^{-4} mrem (1.8×10^{-6} mSv).

Building 776 Demolition: Building 776 was demolished in 2005. The building did not meet free release criteria for radionuclide contamination. Total weapons grade plutonium activity present when the building was demolished was estimated to be 141,431 µCi.

The EDE estimation used the total estimated weapons grade plutonium activity, and the demolition release rate approved in the peer reviewed *Building 776/777 Air Modeling Technical Document* (Kaiser-Hill, 2002). The maximum annual off-Site EDE from the project was estimated to be 3.5×10^{-4} mrem (3.5×10^{-6} mSv).

Building 776 Soil Remediation: Contaminated soils associated with Building 776 were remediated in 2005. Total contaminated soil was estimated to be 11,111 cubic yards (8,495 cubic meters). Maximum radionuclide contamination was measured at 1 nanocurie per gram weapons grade plutonium.

The EDE estimation used the total volume of contaminated soil, maximum detected contamination levels, and emission factors from EPA's *Compilation of Air Pollutant Emission Factors*, AP-42 (EPA, 1995). The maximum annual off-Site EDE from the project was estimated to be 1.7×10^{-3} mrem (1.7×10^{-5} mSv).

B-Series Ponds Sediment Remediation: In 2005, contaminated sediments in the B-series ponds continued to be stabilized and removed. Approximately 27,672 cubic

yards (21,157 cubic meters) of stabilized contaminated sediment were removed in 2004 and 2005. Representative contamination levels were 53 picocuries per gram (pCi/g) Am-241, and 285 pCi/g Pu-239/240.

The EDE estimation used the total volume of contaminated sediment, maximum detected contamination levels, and emission factors from EPA's *Compilation of Air Pollutant Emission Factors*, AP-42 (EPA, 1995). The maximum annual off-Site EDE from the project was estimated to be 4.1×10^{-3} mrem (4.1×10^{-5} mSv). Although emissions from this project occurred in both 2004 and 2005, the entire estimated dose from the project was conservatively assigned to both the 2004 and 2005 Site-wide emission estimates.

3.0 AIR EMISSIONS DATA

This section discusses and quantifies radionuclide emissions from the Site for calendar year 2005. The stacks, vents, and other points where radioactive materials were released to the atmosphere are described, and control measures employed by the Site to minimize emissions are discussed.

3.1 Emission Determination Process

This section presents an estimate of Site radionuclide air emissions during that portion of calendar year 2005 when 40 CFR 61, Subpart H applied. Where air effluent exiting buildings through stacks or vents was continuously sampled and radionuclide emissions measured, those data are presented here. In most cases, however, emissions from activities that generated airborne radionuclides were not measured. For these activities, emissions were estimated based on project-specific information, combined with emission factors from various sources. Emission calculation methods were discussed in detail in previous annual reports (see, for example, DOE, 2005). Emission sources that were clearly negligible were not quantified.

In addition to emissions from specific projects or processes, an ongoing source of radionuclide emissions from the Site is the resuspension of contaminated surface soils by wind erosion. Emissions from this source were estimated by combining information regarding Site-wide surface soil concentrations of radionuclide contaminants with a Site-specific soil resuspension factor. Development of the resuspension factor was discussed in detail in a previous annual report (DOE, 1996). Historical surface soil radionuclide data from a Site-specific soil sampling database were adjusted based on RFCA surface soil action levels (cleanup levels) to provide the contaminant concentration data needed to complete the wind erosion emission calculations.

The emissions discussed in this section include all isotopes that have the potential to contribute 10% or more to the Site's total air pathway EDE. These include:

- Uranium isotopes typical of the depleted and enriched uranium that have been used at the Site, as well as uranium isotopes that are naturally present in Site soils;
- Pu-239/240, which contributes more than 97% of the alpha activity in Site plutonium; and
- Am-241, a decay product of Pu-241, which is a minor component of the weapons-grade plutonium that was used at the Site.

3.2 Point Sources

Radionuclide emissions released through stacks and vents are termed "point" sources. Point source emissions for calendar year 2005 and the control technology used at each point source are described in this section.

3.2.1 Measured Point Source Emissions

During calendar year 2005, only one significant release point remained at which radionuclide air emissions were collected and measured. Significant release points are

those that have the potential to discharge radionuclides into the air in quantities that would result in an annual EDE to the public greater than 1% of the 10-mrem standard, based on uncontrolled emissions (without considering HEPA filtration). Insignificant release points are those that have the potential to discharge radionuclides in lesser quantities. Unless it can be shown to be impractical for a given significant release point, significant release points must be continuously monitored or sampled, while insignificant release points require periodic confirmatory measurements to verify low emissions (40 CFR 61.93).

Sampling was discontinued at other significant release points prior to 2005 because they were undergoing active decommissioning, making it impractical to continue effluent monitoring, or because the buildings had been demolished. During active decommissioning, air flow through the ventilation systems is disturbed sufficiently that the measurement and quantification of radionuclide releases becomes unreliable and no longer representative, or the sampler locations themselves become compromised by removal of necessary infrastructure. At that point, sampling locations were removed from service and any radioactive particulate matter release associated with such locations was accounted for through the compliance sampling network.

Effluent Sampling Methods

Point source emissions were measured at the Site with sampling systems that continuously drew a portion of the duct or vent airstream through a filter. Radioactive particles were collected on the filters, which were generally exchanged weekly. The samples were composited monthly by location and analyzed for plutonium, americium, and uranium isotopes. All radionuclides that could contribute greater than 10% of the potential EDE for a release point were measured during calendar year 2005.

Calendar Year 2005 Effluent Sampling

As of December 31, 2004, effluent sampling was limited to Building 440. The Building 440 sampling system was shut down in April 2005, at which point effluent sampling was permanently discontinued at RFETS. Measured calendar year 2005 emissions of plutonium, americium, and uranium are shown in Table 3-1.

Appendix B shows calendar year 2005 measured point source emissions data, formatted to conform to DOE's Effluent Information System (EIS), a historical database for recording and reporting radioactive effluent data for airborne and waterborne discharges that travel off site from facilities under DOE control. DOE no longer requires its facilities to submit an EIS report.

Table 3-1. Measured Point Source Radionuclide Emissions

Building/ Location[a]	Isotope Emissions (Ci/yr) [b,c,d]				
	Pu-239/240	Am-241	U-233/234	U-235	U-238
440-101	1.385E-10	1.215E-10	8.049E-10	9.147E-11	6.011E-11

[a] The first number in this column designates the building cluster, the second set of characters designates the specific duct(s) or vent(s). The location of 440-101 is shown in Figure 3-1 of this report.

[b] Values were corrected for filter blanks.

[c] Vent 404-101 was controlled by HEPA filters with a tested control efficiency of at least 99.97%.

[d] All isotopes that could contribute greater than 10% of the potential EDE for a release point were measured.

Notes:

Am	=	Americium	Ci/yr	=	Curies per year, 1 Ci = 3.7 x 10^{10} Becquerel (Bq)
E#	=	x $10^{\#}$	EDE	=	Effective dose equivalent
HEPA	=	High efficiency particulate air	Pu	=	Plutonium
U	=	Uranium			

3.2.2 Calculated Point Source Emissions

During 2005, several point sources operated at the Site that did not trigger continuous sampling requirements because they had low emission potential or were of short duration. Sources that continued operation from 2004 included several activities in Tent 5 at the 750 Pad, including a drum crusher, and repackaging of waste chemicals, low-level, and low-level mixed waste; repackaging of TRU-mixed waste at the 750 Pad; and the Trailer 130A laboratory. No new point sources were initiated in 2005. Point sources with calculated emissions that continued operation from 2004 are described below, along with emissions from a minor tritium release during repackaging operations in Building 440. Emissions were calculated for these insignificant release points as described in Section 3.1. Table 3-2 shows calculated point source emission estimates for calendar year 2005.

750 Pad, Tent 5 Drum Crusher: In 2000, a drum crusher was installed within the Tent 5 containment structure at the 750 Pad; intermittent operations continued into 2005. The maximum contamination level of the drums crushed during 2005 was 100,000 disintegrations per minute per 100 square centimeters (dpm/cm^2).

The containment structure air exhausted through a single-stage HEPA filter. For 2005, dose calculations were based on the conservative assumptions that the crusher would operate at the maximum process rate 24 hours per day, 5 days per week, 52 weeks per year and that each drum was contaminated at 100,000 dpm/100 cm^2 over the entire surface area. In fact, the drum crusher operated intermittently for only the first few months of 2005, so the actual emissions would have been substantially less than shown.

Table 3-2. Calculated Point Source Radionuclide Emissions

Activity or Building	Isotope Emissions (Ci/yr) [a]					
	Pu-239/ 240	Am-241	U-233/ 234	U-235	U-238	Tritium
750 Pad, Tent 5 Drum Crusher[b]	4.7E-08	4.2E-09	--	--	--	--
Trailer 130A Laboratory[b]	1.1E-09	1.3E-10	--	--	--	--
750 Pad, Tent 5 Low-level and Low-level Mixed Waste Repackaging[b]	1.4E-07	1.6E-08	--	--	--	--
750 Pad, Tent 5 Waste Chemical Repackaging[b]	2.2E-06	2.3E-07	--	--	--	--
Building 440 Repackaging	--	--	--	--	--	2.1E-09

[a] Emissions of all isotopes that could contribute greater than 10% of the potential EDE for a release point were estimated. Isotopes for which emissions were not estimated are shown as "--". The locations of the release points listed are shown in Figure 3-1 of this report.

[b] HEPA filtration used with a control efficiency of at least 99.97 percent.

Notes:

Am	=	Americium	Ci/yr	=	Curies per year, 1 Ci = 3.7 x 10^{10} Becquerel (Bq)
E#	=	x $10^{\#}$	EDE	=	Effective dose equivalent
HEPA	=	High efficiency particulate air	Pu	=	Plutonium
U	=	Uranium	--	=	Not estimated/negligible

Trailer 130A Laboratory: In 2005, Trailer 130A was used for radiological sample collection, receiving, packaging, and shipping, as well as gamma spectroscopy operations and low-level analytical services. Maximum process rates, and worst-case scenario radiological activity, were taken from Appendix 2 of the "Auditable Safety Analysis" document for Building T130A (Kaiser-Hill, 2003).

Low-level sample work was performed in fume hoods, and high-level sample work was performed in gloveboxes that exhausted through at least one stage of HEPA filters. The off-Site EDE was calculated based on the maximum process rates, worst-case scenario radiological activity, and an emission factor from Appendix D to 40 CFR 61.

750 Pad, Tent 5 Repackaging of Waste Chemicals: In 2005, drums of legacy waste chemicals were repackaged in Tent 5 on the 750 Pad. The drums were evaluated, characterized, and repackaged for off-Site disposal, or returned to on-Site storage.

The repackaging operation exhausted through two stages of HEPA filters. Dose calculations for this project were based on the conservative assumption that all drums were at the maximum concentration for low-level waste (100 nanocuries plutonium per gram waste), on the assumption that there would be 20 drums open to the atmosphere at all times, and on emission factors from 40 CFR 61, Appendix D.

750 Pad, Tent 5 Repackaging of Low-level/Low-level Mixed Waste: In 2005, low-level/low-level mixed waste was repackaged in Tent 5 on the 750 Pad. Waste drums and boxes that were identified as non-compliant for off-Site disposal were transported to Tent 5, characterized, sorted, and repackaged to bring them into compliance. The

repackaged containers were then stored for shipment to an approved off-Site disposal facility.

Negative air pressure was maintained within the repackaging containment structures, and air was exhausted through at least one stage of HEPA filters. Dose calculations for this project were based on the conservative assumption that all waste forms were at the maximum concentration for low-level waste (100 nanocuries plutonium per gram waste), on the assumption that the process would operate at its maximum design rate, and on emission factors from 40 CFR 61, Appendix D.

Tritium Release in Building 440: In 2005, tritium was released from a drum in Building 440. The concentration of tritium in the drum was estimated to be 200 μCi per cubic meter. The EDE estimation used the total volume of a drum (0.208 cubic meters) and the measured tritium concentration.

Unmonitored Building Stacks and Vents: Small amounts of radionuclides continued to be released from various insignificant release points during a portion of 2005. Individually, none of these release points had the potential to release radionuclides in amounts that could result in an off-Site EDE in excess of 1% of the 10 mrem standard, even if the emissions were uncontrolled. Many of these release points were controlled by two or more stages of HEPA filters; consequently, actual emissions would have been a fraction of a percent of the standard limitation. As a result, no attempt has been made to estimate emissions from these sources; instead, the compliance sampling network data have been used to demonstrate that none of these points released significant quantities of radionuclides during calendar year 2005 (see Section 4.1 of this report).

3.2.3 Control Technology for Point Sources

HEPA filters were used to control radioactive particulate matter emissions from air effluent systems, including vent 440-101, until the ducts or related infrastructure were decommissioned. Effluent air from areas where plutonium or plutonium-contaminated wastes were processed was typically cleaned by a minimum of four stages of HEPA filters. Effluent air from uranium processing areas was generally cleaned by a minimum of two stages of HEPA filters. HEPA filters meet a minimum filter efficiency of 99.97% (Novick, et al., 1985).

The Trailer 130A laboratory operations, and the 750 Pad Tent 5 chemical repackaging, TRU-mixed sludge repackaging, low-level/low level mixed waste repackaging, and drum crusher operations were each controlled by a minimum of one HEPA filter.

3.3 Nonpoint Sources

Radionuclide emissions that are not released through specific stacks or vents are termed "nonpoint" (or diffuse) sources. Table 3-3 summarizes emissions from nonpoint sources for calendar year 2005.

3.3.1 Nonpoint Source Descriptions

In calendar year 2005, nonpoint sources of radionuclide emissions at the Site included resuspension of contaminated soils by wind erosion and by mechanical disturbance due to

excavation, handling, and vehicle traffic. Mechanical disturbance of contaminated soils was associated with:

- B-Series Ponds Sediment Remediation (continued from 2004); and
- Building 776 Soil Remediation

Calendar year 2005 nonpoint sources also included the demolition of Buildings 707, 776, 371, 374, 883, 444, 559, and 528.

Structures demolished during 2005 also included the following buildings and trailers that were not radiologically contaminated above free release criteria. Therefore, no radionuclide emissions were calculated for these demolition projects:

- Buildings 439, 331, East access buildings, 928, 460, 520, 681, 440, West access buildings, 764, 765, and 891.
- Trailers 130 complex, 750 Trailers A-G, 701, and 707 C, D, and E.

3.3.2 Control Technology for Nonpoint Sources

Particulate emissions from significant earth-moving activities at the Site and from decommissioning activities were controlled by water spray or other dust suppression measures, with an estimated control efficiency of 50%. Fugitive dust control plans that specify the control measures to be used to minimize emissions of contaminated dust were developed for each project with the potential to generate substantial dust emissions from soil or debris handling, or from demolition activities. For calculational purposes, all projects listed in Table 3-3 were assumed to be uncontrolled, even though fugitive dust control measures were employed for most of the projects.

3.4 Release Locations

Figure 3-1 shows the location of various emission sources listed in Tables 3-1 through 3-3.

Table 3-3. Nonpoint Source Radionuclide Emissions

Source or Project[b]	Isotope Emissions (Ci/yr)[a]				
	Pu-239/240	Am-241	U-233/234	U-235	U-238
Resuspension by Wind Erosion	2.5E-05	7.9E-06	2.2E-08	1.6E-08	1.5E-07
B776 Soil Remediation	6.5E-05	7.6E-06	--	--	--
B-Series Ponds Sediment Remediation[c]	1.4E-04	2.6E-05	--	--	--
Building 444 Demolition	--	--	2.6E-08	3.5E-09	2.4E-07
Building 374 Demolition	6.4E-08	7.6E-09	--	--	--
Building 371 Demolition	7.0E-06	8.7E-07	--	--	--
Building 707 Demolition	1.3E-08	1.6E-09	--	--	--
Building 883 Demolition	--	--	6.3E-07	5.2E-08	4.6E-06
Building 776 Demolition	1.3E-05	1.5E-06	--	--	--
Building 528 Demolition	7.0E-07	8.7E-08	--	--	--
Building 559 Demolition	1.7E-06	2.1E-07	--	--	--

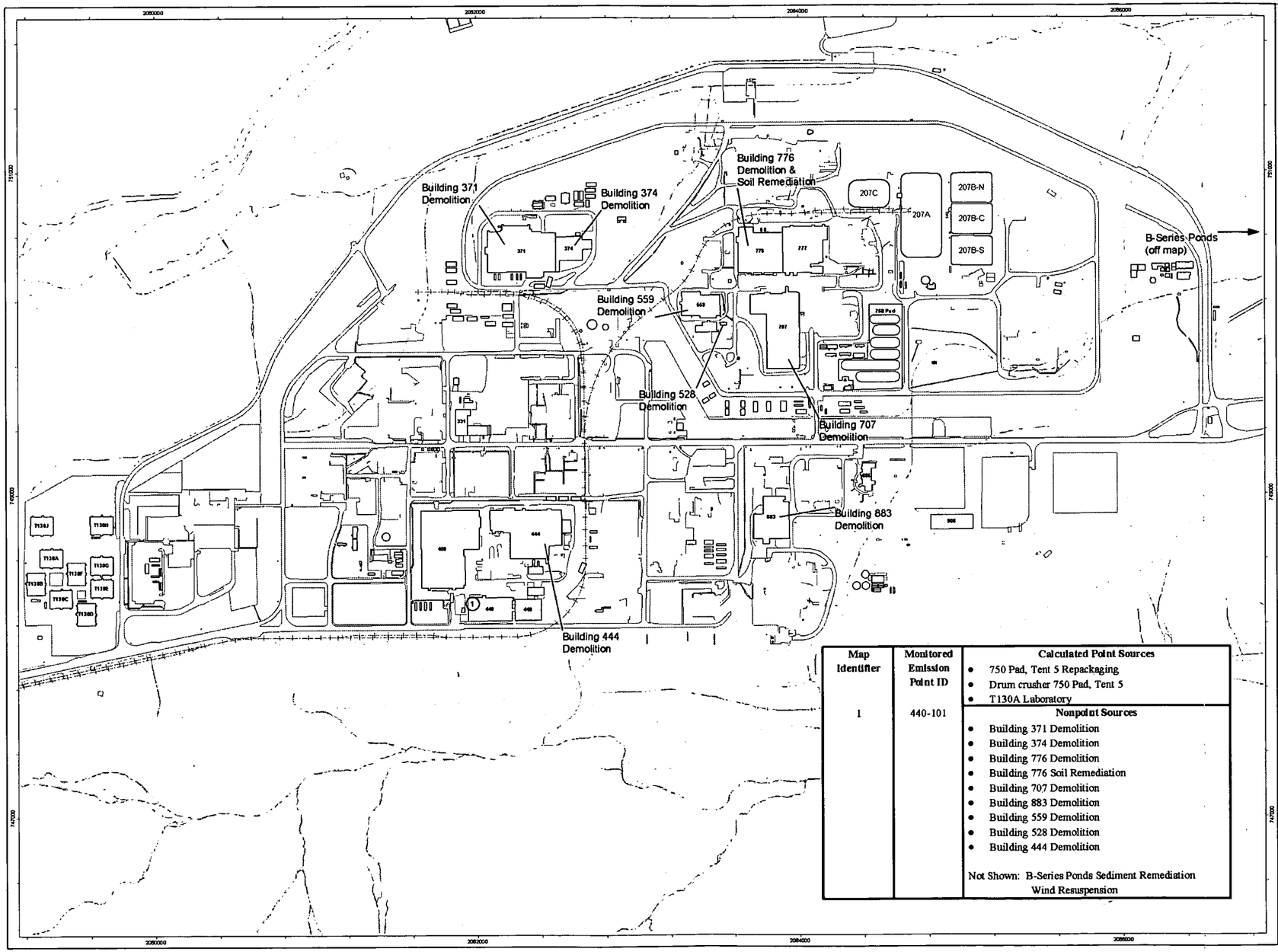
[a] Emissions of all isotopes that could contribute greater than 10% of the potential EDE for a release point were estimated. The locations of the nonpoint release emission sources, except for wind resuspension areas and B-series pond remediation activities, are shown in Figure 3-1 of this report.

[b] Emissions assumed to be uncontrolled.

[c] Project continued from 2004. Total emissions over both years shown.

Notes:

Am	=	Americium
Ci/yr	=	Curies per year, 1 Ci = 3.7 x 10^{10} Becquerel (Bq)
E#	=	x$10^{\#}$
EDE	=	Effective dose equivalent
Pu	=	Plutonium
U	=	Uranium



Map Identifier	Monitored Emission Point ID	Calculated Point Sources
1	440-101	• 750 Pad, Tent 5 Repackaging • Drum crusher 750 Pad, Tent 5 • T130A Laboratory **Nonpoint Sources** • Building 371 Demolition • Building 374 Demolition • Building 776 Demolition • Building 776 Soil Remediation • Building 707 Demolition • Building 883 Demolition • Building 559 Demolition • Building 528 Demolition • Building 444 Demolition Not Shown: B-Series Ponds Sediment Remediation Wind Resuspension

Rocky Flats Environmental Technology Site

Figure 3-1

Industrial Area Source Locations 2005

Map Features

- Buildings as of January 2005
- Paved Roads
- Dirt Roads
- Solar Evaporation Pond (Removed)
- Lakes
- Streams
- Railroad Tracks
- Fences

N

1:7,000
1 inch equals 580 feet

State Plane Coordinate Projection
Colorado Central Zone (3476)
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. (303) 966-7707

Prepared By: CH2MHILL
Prepared For: KAISER-HILL COMPANY

October 31, 2005

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4.0 COMPLIANCE ASSESSMENT

This section describes the compliance assessment performed for the Site for that portion of the 2005 calendar year during which 40 CFR 16, Subpart H applied.

4.1 Compliance Demonstration Based on Environmental Measurements

Historically, the Site demonstrated compliance with the 10-mrem public dose standard in 40 CFR 61, Subpart H, through emission measurement or estimation and dispersion modeling of Site emissions to determine the dose to the most impacted off-Site resident. Beginning with calendar year 1998, the Site transitioned to an alternative compliance demonstration method based on environmental measurements, as allowed by 40 CFR 61.93(b)(5). The calendar year 2005 compliance assessment is based on the alternative method, which is described below.

4.1.1 Description of Compliance Sampling Network

The Site operated a network of high-volume, size-fractionating ambient air samplers located on and around the Site, and in nearby communities (the RAAMP network). The compliance sampling network consisted of 14 of these samplers located along the Site perimeter. The compliance sampling network is shown in Figure 4-1, along with nearby businesses or residences (receptors).

The ambient air samplers continuously collected both fine (aerodynamic diameter less than approximately 10 micrometers) and coarse (aerodynamic diameter between about 10 and 25 micrometers) particulate matter fractions on filters and removable impactor surfaces that were exchanged and analyzed on a monthly schedule through late September 2005. The samples were analyzed for the plutonium, americium, and uranium isotopes that represent most of the radioactive materials handled at or residing on the Site. These isotopes account for all materials that have the potential to contribute 10% or more of the dose to the public.

Residential and commercial development on and around the Site was reviewed quarterly. No development that warranted additional or revised sampler location occurred in calendar year 2005.

Following the transition in 1999 to the alternative compliance demonstration method, effluent collection and measurement were discontinued for insignificant release points. The ambient network was used to verify low emissions from these locations in 2005, as required by Section 61.93(b)(4).

4.1.2 Compliance Sampling Network Measurements for 2005

Filters from the compliance sampling network were generally exchanged monthly through late September 2005, then analyzed for Pu-239/240, Am-241, U-233/234, U-235, and U-238. (In a few cases, high dust loading required that filters be exchanged more often. When this was necessary, the filters were composited for the month by location and the composite sample was analyzed for the isotopes listed above.)

Average isotopic concentrations were calculated at each sampler from monthly isotopic concentration and sample volume data. The average isotopic concentrations for January through September 2005 at each compliance sampler are shown in Table 4-1.

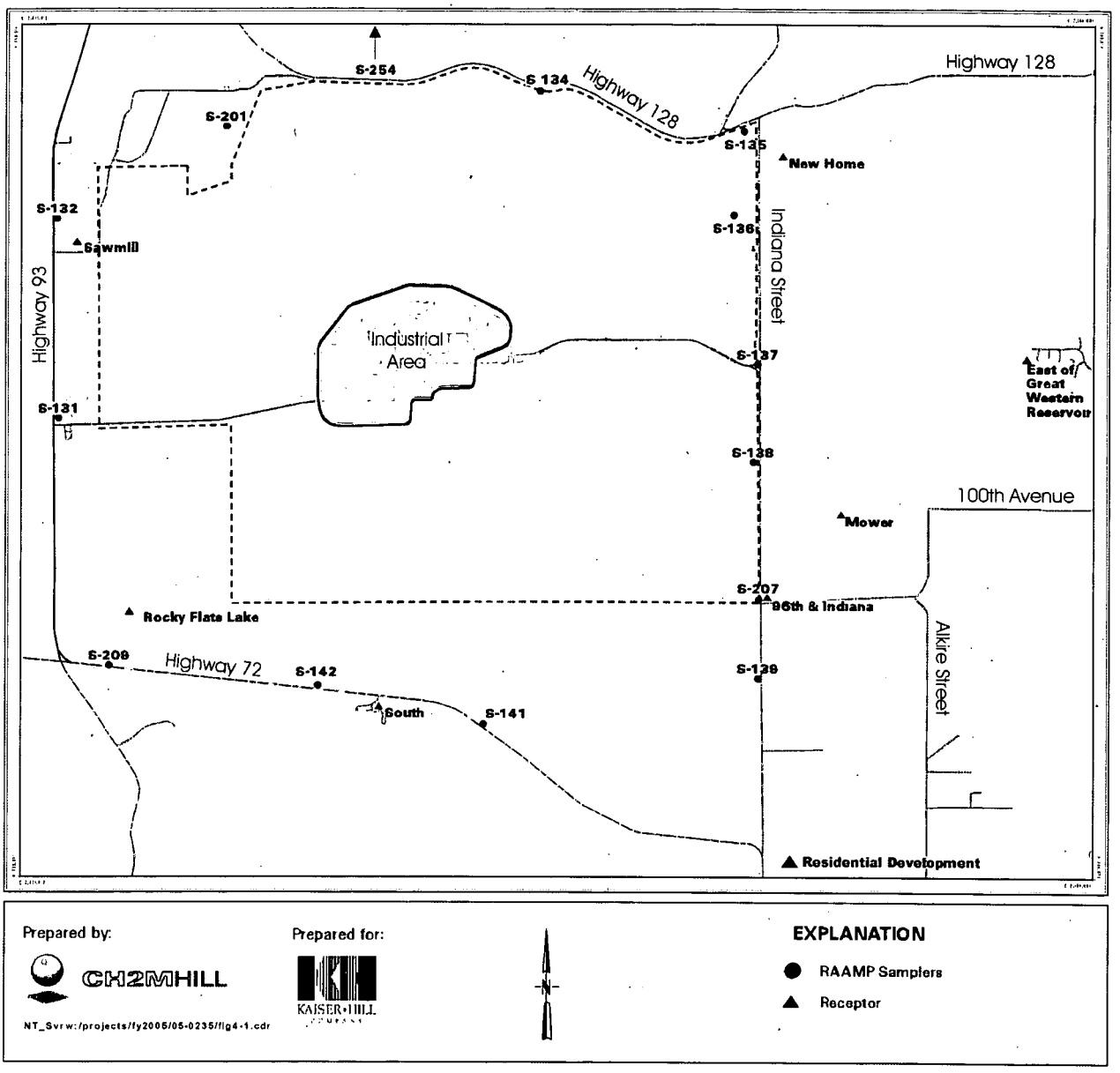

Figure 4-1. Receptor Locations and Nearby Samplers

Table 4-1. Nine-Month and Annual Average Isotopic Concentrations at Compliance Sampling Network Locations

Sampler and Time Period[a]	Pu-239/240 (Ci/m^3)	Am-241 (Ci/m^3)	U-233/234 (Ci/m^3)	U-235 (Ci/m^3)	U-238 (Ci/m^3)	Fractional Sum
S-131: 1/05-9/05	7.84E-18	4.49E-19	4.14E-17	2.56E-18	4.35E-17	0.0156
Rolling 12-month	5.94E-18	3.35E-19	3.79E-17	2.05E-18	3.93E-17	0.0135
S-132: 1/05-9/05	3.05E-17	2.10E-18	4.08E-17	1.25E-18	4.36E-17	**0.0275**
Rolling 12-month	2.27E-17	1.57E-18	3.87E-17	1.11E-18	4.03E-17	**0.0227**
S-134: 1/05-9/05	1.78E-18	3.51E-19	1.34E-17	3.33E-19	1.34E-17	0.0046
Rolling 12-month	1.36E-18	3.67E-19	1.27E-17	3.34E-19	1.32E-17	0.0043
S-135: 1/05-9/05	1.13E-17	1.54E-18	2.08E-17	6.25E-19	2.10E-17	0.0120
Rolling 12-month	8.43E-18	1.15E-18	1.97E-17	5.54E-19	2.04E-17	0.0101
S-136: 1/05-9/05	1.26E-17	1.56E-18	1.85E-17	1.00E-18	1.73E-17	0.0120
Rolling 12-month	9.57E-18	1.17E-18	1.69E-17	7.43E-19	1.64E-17	0.0099
S-137: 1/05-9/05	4.06E-18	7.02E-19	1.88E-17	9.46E-19	1.87E-17	0.0074
Rolling 12-month	3.59E-18	7.74E-19	1.92E-17	9.60E-19	1.88E-17	0.0073
S-138: 1/05-9/05	2.29E-18	5.95E-19	1.86E-17	3.34E-19	1.77E-17	0.0063
Rolling 12-month	2.63E-18	5.20E-19	1.88E-17	2.49E-19	1.73E-17	0.0064
S-139: 1/05-9/05	9.37E-18	9.14E-19	2.21E-17	9.04E-19	2.15E-17	0.0110
Rolling 12-month	7.21E-18	7.01E-19	2.09E-17	7.59E-19	1.99E-17	0.0094
S-141: 1/05-9/05	7.56E-20	2.14E-19	1.78E-17	1.02E-18	1.54E-17	0.0047
Rolling 12-month	9.42E-20	2.18E-19	1.67E-17	1.21E-18	1.52E-17	0.0045
S-142: 1/05-9/05	2.16E-18	1.82E-19	1.80E-17	6.92E-19	1.76E-17	0.0059
Rolling 12-month	1.76E-18	1.80E-19	1.71E-17	5.65E-19	1.71E-17	0.0055
S-201: 1/05-9/05	5.18E-18	7.87E-19	1.99E-17	7.59E-19	2.03E-17	0.0084
Rolling 12-month	3.89E-18	6.74E-19	1.96E-17	6.78E-19	2.01E-17	0.0076
S-207: 1/05-9/05	1.45E-18	2.99E-19	2.52E-17	8.16E-19	2.46E-17	0.0075
Rolling 12-month	1.17E-18	3.05E-19	2.38E-17	6.08E-19	2.29E-17	0.0069
S-209: 1/05-9/05	2.53E-18	6.67E-19	2.36E-17	1.04E-18	2.35E-17	0.0079
Rolling 12-month	2.31E-18	4.98E-19	2.14E-17	1.05E-18	2.16E-17	0.0072
S-254: 1/05-9/05	1.07E-18	6.18E-19	5.85E-17	2.42E-18	5.89E-17	0.0165
Rolling 12-month	8.15E-19	4.61E-19	5.27E-17	2.28E-18	5.31E-17	0.0148
Compliance Level (Ci/m^3)[b]	**2.0E-15**	**1.9E-15**	**7.1/7.7E-15**	**7.1E-15**	**8.3E-15**	**1**

[a] Rolling 12-month period is from October 2004 through September 2005

[b] Compliance levels are listed for each isotope in Table 2 of Appendix E to 40 CFR 61.

Notes:

Am	=	Americium
Ci/m^3	=	Curies per cubic meter; 1 Ci = 3.7 x 10^{10} Becquerel (Bq)
E#	=	x $10^{\#}$
Pu	=	Plutonium
U	=	Uranium

Table 4-1 also shows a 12-month rolling average concentration (through September 2005) for each sampler and isotope.

Two *fractional sums* were calculated for each sampler location by dividing each January through September 2005 or rolling 12-month isotopic concentration by that isotope's corresponding *compliance level* as listed in Table 2 of Appendix E to 40 CFR 61, then summing the fractions. The fractional sums are also shown in Table 4-1.

4.2 Compliance Assessment Results

This section discusses the results of the compliance assessment for calendar year 2005.

4.2.1 Compliance Demonstration

As reported in Section 4.1 of this report, the maximum 2005 and rolling 12-month concentrations of Pu-239/240, Am-241, U-233/234, U-235, and U-238 measured at the compliance sampling network were compared to the compliance levels listed in Table 2 of Appendix E to 40 CFR 61. In each case, the maximum measured concentration of each isotope, as shown in Table 4-1, was less than 3% of the corresponding compliance level. In addition, the fractional sum of all isotopes at the *critical receptor* location (the sampler showing the highest concentrations in 2005) was determined to be 0.0275 on a 9-month calendar year basis, or 0.0227 on a rolling 12-month basis. (This corresponds to annual doses of 0.275/0.227 mrem, or 2.75%/2.27% of the 10-mrem standard.) The facility is in compliance when the annual concentration of each isotope is less than its corresponding Table 2 compliance level and when the fractional sum of all isotopes is less than 1.

Figure 4-2 shows rolling 12-month data through September 2005 at all compliance sampling network locations. The data are presented as percentages of the compliance level for each isotope; the total height of each bar in Figure 4-2 represents the fractional sum expressed as a percent of the allowable sum (percent of 1). Data are presented for each sampler, beginning with S-131 at the west gate of the Site, and continuing around the Site perimeter in a clockwise direction. Sampler locations are shown in Figure 4-1.

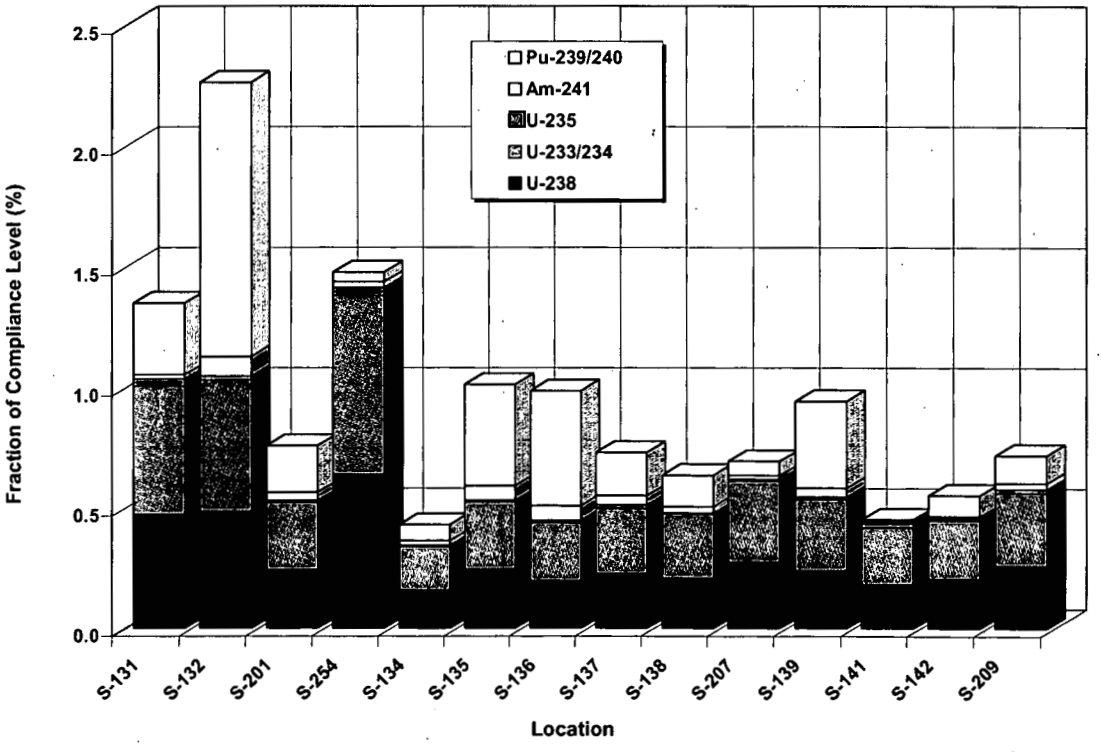

Figure 4-2. Environmental Measurements of Airborne Radionuclides in 2005

In 2005, the maximum measured radionuclide levels occurred to the northwest of the Site, at sampler S-132. This is the same sampler that had the highest measured radionuclide concentrations in 1998, 1999, 2000, 2001, and 2002. (In 2003 and 2004, sampler S-254, located north of the Site along a dirt road that has seen increased traffic volumes due to local development, had the highest measured radionuclide concentrations across the compliance sampling network. In 2005, sampler S-254 again showed higher measured concentrations of uranium than any other compliance sampler, most likely related to local dust sources combined with naturally occurring uranium isotopes in the soils surrounding Rocky Flats.)

Examination of the isotopic data presented in Table 4-1 and Figure 4-2 shows that the higher overall radionuclide levels (fractional sum) at S-132, relative to other samplers in the compliance sampling network, was primarily due to Pu-239/240, along with fiarly large contributions from U-233/234 and U-238. The ratio of U-233/234 to U-238 activities at S-132 (and at other compliance samplers) was close to 1:1, which is characteristic of naturally occurring uranium. (In contrast, depleted or enriched uranium that might be emitted from on-Site sources would show different isotopic ratios.) Figure 4-3 shows the isotopic breakdown at S-132 as a percentage of the total fractional sum at that location (based on a 12-month rolling average); over 50% of the fractional sum is due to Pu-239/240.

A large number of activities occurred during 2005 that could have contributed to elevated Pu-239/240 concentrations (relative to past years) at S-132 or other samplers due to dust emissions, including demolition of several buildings containing contamination above free release levels, waste and rubble removal, and Site contouring and grading. Dust emissions from demolition activities performed during daytime upslope flow conditions would have contributed to the air concentrations observed at this sampling location.

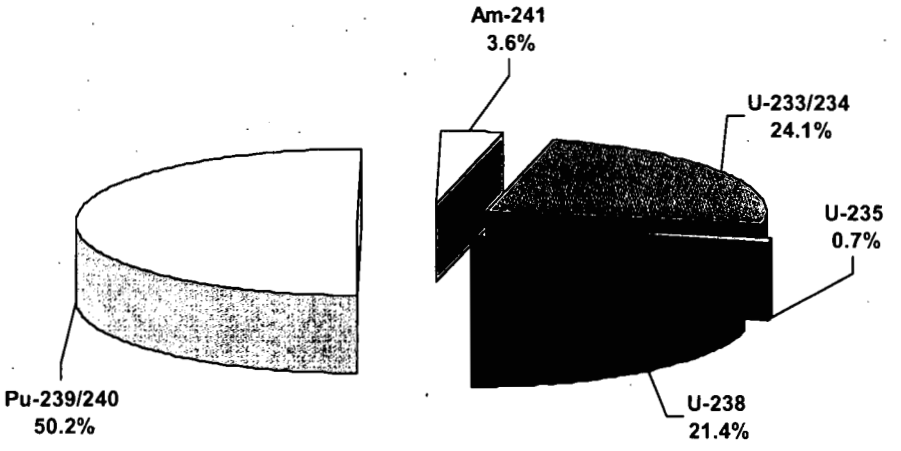

Figure 4-3. Isotopic Contribution to the Fractional Sum at the Critical Receptor

Also, a number of samplers showed evidence of elevated dust levels at times during 2005, requiring filter exchanges more frequently than monthly, although whether this was related to Site activities or simply due to other local dust emitting sources, such as sand and gravel operations, is unknown. In past years it has been noted that samplers exposed to higher particulate matter concentrations often show increased radionuclide concentrations compared with less dusty locations, if only due to the collection of more "sample" during the month. S-132 required mid-month filter exchanges during several months, including June 2005, when the highest monthly Pu-239/240 concentrations were recorded. Note that although the Pu-239/240 activity levels recorded at S-132 during June 2005 were higher than those seen at other samplers for the same time period, they still represent an annual dose rate an order of magnitude below the 10 mrem standard.

Naturally occurring uranium isotopes were important contributors to airborne radionuclide levels at all compliance samplers in 2005. The sum of U-233/234 and U-238 activity ranged from 44% to over 93% of the fractional sum at all compliance samplers in 2005.

Figure 4-4 shows the measured levels of Pu-239/240 and Am-241 at the compliance sampling network locations, also presented as percentages of the compliance level for each isotope. These two isotopes are characteristic of the weapons-grade plutonium that was used at the Site.

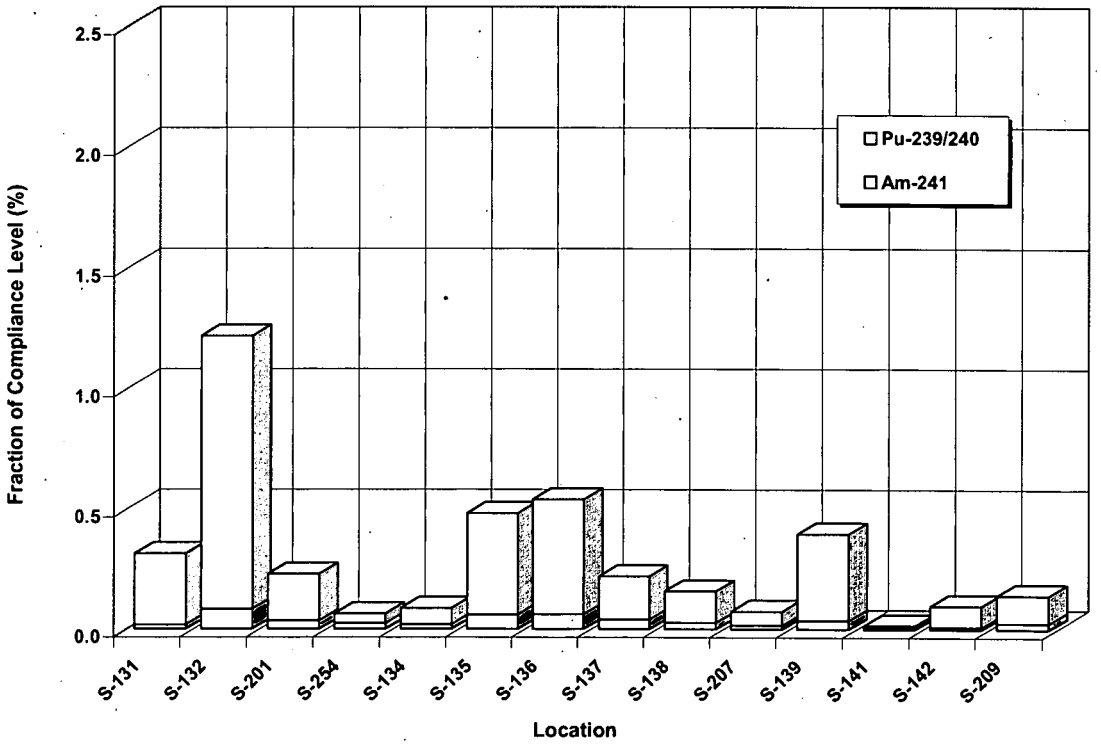

Figure 4-4. Environmental Measurements of Pu-239/240 and Am-241 in 2005

The fractional sum information for calendar year 2005 for the critical receptor can be compared with the 10-mrem dose limit and with data from prior years. As noted previously, the fractional sum at the critical receptor location in 2005 was 0.0227-0.0275 (based on 12-month or 9-month averages). The fractional sum can be directly related to the allowable dose limit of 10 mrem in 40 CFR 61, Subpart H, for which the fractional-sum limit is 1. As a result, the maximum dose recorded at the compliance sampling network in 2005 was nearly two orders of magnitude below the 10-mrem limit. For comparison, fractional sums at the critical receptor were 0.0156 in 2004, 0.0252 in 2003, 0.0156 in 2002, 0.0128 in 2001, 0.0130 in 2000, 0.0145 in 1999, 0.0141 in 1998, and 0.0128 in 1997.

4.2.2 Statement of Compliance Status

Compliance with the 10-mrem standard has been determined by comparing environmental radionuclide air concentration measurements at the critical receptor location with the "Concentration Levels for Environmental Compliance" listed in Table 2 of Appendix E to 40 CFR 61. Compliance is demonstrated when each measured radionuclide air concentration is less than its corresponding compliance level in Table 2 and when the fractional sum of all radionuclides is less than 1. For 2005, each measured radionuclide air concentration was less than 3% of its corresponding compliance level and the fractional sum of all radionuclides was less than 3% of the allowable level at the critical receptor (the sampler with the highest fractional sum). The Site was in compliance with the 10-mrem standard during 2005.

4.3 Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. (See 18 USC 1001.)

Scott Surovchak
Rocky Flats Site Manager
Office of Legacy Management
US Department of Energy

Signature Date

5.0 SUPPLEMENTAL INFORMATION

The following information is provided pursuant to DOE guidance or EPA request and is not required by 40 CFR 61, Subpart H, reporting requirements.

- **Calendar year 2005 collective dose:** DOE facilities such as the Site are required to estimate the collective dose to the surrounding population on an annual basis by DOE Order 5400.5, *Radiation Protection of the Public and the Environment.* While not a requirement of 40 CFR 61, Subpart H, the collective dose calculation for the air pathway has typically been reported in this annual report. Collective dose is defined as the sum of the EDEs of all individuals in an exposed population within an 80-km radius of the center of the Site (DOE, 1990).

  For calendar year 2005, the population distributions that form the basis of the collective dose calculation were updated. Estimated population growth figures for 2000 to 2005 were obtained for the counties located within 80 km of the Site from the State of Colorado, Department of Local Affairs, Demography Section. Similar estimates were obtained for counties in the metropolitan Denver area from the Denver Regional Council of Governments (DRCOG). Where two growth projections were obtained for a single county, the projections were averaged. Percentage growth estimates were applied to 2000 census data for each census tract within 80 km of the Site to obtain 2005 population values for modeling.

  The collective dose was calculated with CAP88-PC, as described in Appendix C. The collective dose for calendar year 2005 was 1.19 person-rem (0.0119 person-Sv).

- **Other radionuclide regulations:** 40 CFR 61, Subparts T and Q (CAQCC Regulation No. 8, Part A, Subparts T and Q) are not applicable to this Site. Subparts T and Q contain standards for radon emissions from specific facilities.

- **Unplanned releases:** In 2005, tritium was released from a drum in Building 440. The concentration of tritium in the drum was estimated to be 200 µCi per cubic meter. The EDE estimation used the total volume of a drum (0.208 cubic meters) and the measured tritium concentration. The maximum annual off-Site EDE from this event was estimated to be 2.1×10^{-9} mrem (2.1×10^{-11} mSv).

- **Coarse and fine particulate matter fractions:** As described previously, the compliance network samplers collected both fine and coarse particulate matter on filters and removable impactor surfaces. The fine fraction contains smaller particles that could reach and be retained in the lung, while the larger coarse fraction particles are more likely to be removed from the airstream before reaching the lungs. As a result, radionuclides in the fine fraction of the particulate matter constitute a higher health risk than those in the coarse fraction.

  To determine how much of the annual radionuclide activity measured at the compliance sampling network in 2005 was due to fine particles, the fine and coarse fraction data were examined for the critical receptor location, where the maximum calculated dose occurred (sampler S-132). Monthly concentrations at S-132 for all radionuclides measured (sum of Am-241, Pu-239/240, U-233/234,

U-235, and U-238) ranged from 11% to 51% fine particles, with an average of 31% in the fine fraction. Am-241 and Pu-239/240 ranged from 0% to 100% each in the fine fraction on a monthly basis, averaging 21% and 23% fine particles, respectively. For U-233/234 and U-238, the fine fraction varied monthly between 15% and 51% for U-233/234 (averaging 37%) and between 0% and 50% for U-238 (averaging 37%).

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APPENDIX A

RADIOACTIVE MATERIALS ASSOCIATED WITH ROCKY FLATS

RADIOACTIVE MATERIALS ASSOCIATED WITH ROCKY FLATS CALENDAR YEAR 2004

(Information not updated for 2005; no new source material was added and, by mid-2005, all sources had been removed from the Site)

A. RADIOACTIVE MATERIALS PRESENT IN KILOGRAM QUANTITIES

1. Enriched Uranium

Common Name: Oralloy
Normal Isotopic Composition: >90% U-235

2. Depleted Uranium

Common Names: Tuballoy, D-38, U-238
Normal Isotopic Composition: <0.71% U-235

3. Natural Uranium (Thorium and Uranium-233)

Rocky Flats has historically had the capability to handle these in kilogram quantities and some of these materials have been handled in the past.

B. RADIOACTIVE MATERIALS PRESENT IN GRAM QUANTITIES (<1 kilogram)

Plutonium-239,-240

C. RADIOISOTOPES USED AT ROCKY FLATS AS ACCOUNTABLE AND/OR TRACEABLE/NONACCOUNTABLE SOURCES

1. Traceable (Nonaccountable) Sources

Sealed solids < Appendix E values[1]
Plated solids < Appendix E values
Liquids < 10^{-3} μCi

Americium	(Am-241)
Barium	(Ba-133)
Californium	(Cf-252)
Carbon	(C-14)
Cesium	(Cs-137)
Chlorine	(Cl-36)
Cobalt	(Co-57, -60)
Europium	(Eu-154)
Gadolinium	(Gd-148)
Plutonium	(Pu-238, -239)
Radium	(Ra-226)
Strontium	(Sr-90)
Thorium	(Th-230)
Uranium	(U-234, -235,-238)

[1] Accountability is determined by 10 CFR 835, Appendix E. Sealed radioactive sources with activities equal to or greater than Appendix E values are accountable. The activities are individual for each isotope and are not all equal in value.

APPENDIX B

EFFLUENT INFORMATION SYSTEM (EIS) DATA
2005

Summary Table For The EIS/ODIS Database
2005-Release (Ci)

02_ODIS Location	ODIS Location Code	N	Effluent Volume (m^3)	Plutonium 239/240	Americium 241	Uranium 233/234	Uranium 235	Uranium 238
440-101	--	12	2.096E+07	1.281E-10	8.758E-11	8.052E-10	1.150E-10	3.529E-11
RFETS	--	12	2.096E+07	1.281E-10	8.758E-11	8.052E-10	1.150E-10	3.529E-11

Notes:

Ci = Curies
EIS = Effluent Information System
m^3 = Cubic meters
N = Number of samples analyzed
ODIS = On-Site Discharge Information System
RFETS = Rocky Flats Environmental Technology Site

APPENDIX C

MODELING SUMMARY

MODELING SUMMARY

Model Description and Use

CAP88-PC is a dispersion and dose model that has historically been used at the Site for calculating EDE to both individual members of the public and to the surrounding population within 80 km. The model simulates the dispersion of airborne radionuclide emissions from point and nonpoint (termed "area") sources to user-specified receptor locations, then calculates an annual, multipathway EDE for a person living or working at each specified receptor location. When combined with population distribution information, CAP88 estimates the collective dose to the surrounding population.

Summary of Model Input Data

The model accounts for dose received from Site emissions through inhalation and ingestion of radionuclides in air and deposited on the ground surface. To simulate pollutant dispersion and calculate dose, the model requires the following types of input data:

- Distance and direction from emission sources to receptor locations.
- Source release characteristics, including stack locations, stack heights, exhaust gas velocities and temperatures, the size of each stack or vent opening for point sources, and the size and location of each area source.
- The amount of each radioactive isotope released from each source.
- Meteorological data including the distribution of wind speed and wind direction at the Site, and precipitation and temperature information. The model also requires information about the average height of regional temperature inversions (mixing height).
- Agricultural data used in calculating radionuclide ingestion rates including the location, distribution, and utilization of local and regional sources of meat, milk, and vegetables.
- Miscellaneous data regarding the size and solubility of the particles emitted.

To calculate the calendar year 2005 collective dose, Site emissions (sum of all emissions shown in Tables 3-1, 3-2, and 3-3, by isotope) were modeled from a single area source located at the center of the Site. The source was assumed to have an area of 5.3×10^6 square meters (m^2) (about 20% of the total Site area), release height of 0.0 m, and no momentum plume rise (exit velocity of 0.0 meters per second [m/s]). These release characteristics were appropriate for the major source of radionuclide emissions in calendar year 2005, which was resuspension of contaminated soil and dust from wind and from mechanical disturbance during demolition and remediation activities.

Meteorological data for calendar years 2000-2004 were averaged for use in the model (data for individual years are documented in previous annual reports). A joint frequency distribution of wind speed and wind direction was processed for input to CAP88-PC.

Graphical representations of winds (wind roses) from 2000-2004 were shown in previous annual reports.

Averaged precipitation and temperature data for 2000-2004 show:

- Total average precipitation: 39.37 cm; and
- Average temperature: 10.25°C.

An average mixing height for the Denver, Colorado, area of 1,405 m was used in the model (EPA, 1972).

The CAP88-PC model calculated EDEs over a polar coordinate receptor grid. The grid consisted of 16 compass sectors and 12 distances from the center of the Site: 2 km, 3 km, 6 km, 10 km, 15 km, 20 km, 24.5 km, 29.5 km, 39 km, 49 km, 64.5 km, and 80 km. CAP88-PC estimates an EDE at the midpoint of each grid cell, then multiplies each EDE by the population within the grid cell to calculate collective dose. Population data for the 2000 census were obtained, organized by census tract, and each whole or partial census tract within 80 km of the Site was assigned to a grid cell. The 2000 census data were scaled up for 2005 using growth estimates by county obtained from the State of Colorado, Department of Local Affairs, Demography Section, and DRCOG.

Model default values were used for the median aerodynamic diameter (1.0 micrometers) and solubility class. Urban agricultural data were used in the model. Default values were also used cattle density and for the land fraction cultivated for vegetable crops.

The total collective dose was calculated as the sum of the contributions from Pu-239/240, Am-241, U-233/234, U-235, and U-238.